

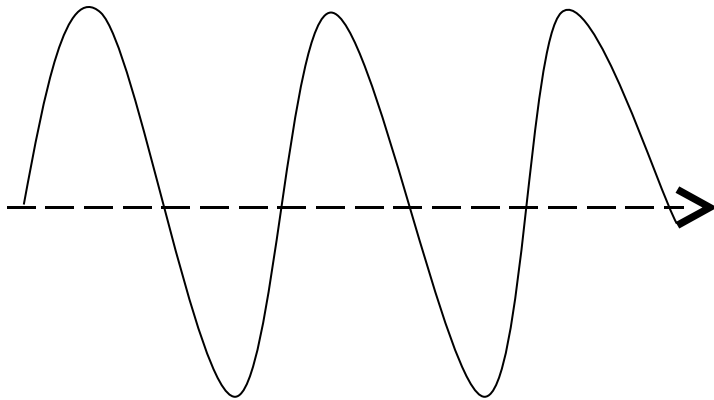
Mechanical Waves

A mechanical wave is a rhythmic disturbance in a medium produced by mechanical energy applied to the medium. Wave motion is also called an oscillation. There are two types of waves, transverse and longitudinal. The most familiar picture of a wave to most people is that of a transverse wave:

The main characteristics of a wave are its **amplitude, wavelength, frequency, period, and wave speed.**

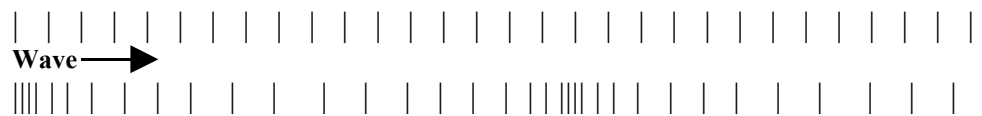
Visible parts of a *transverse* wave include the **crest, trough, and rest position.** Visible parts of a *longitudinal* wave include the **compression, rarefaction, and rest position.**

TRANSVERSE



LONGITUDINAL

Rest Position



Be aware that we are looking at still pictures of energy in motion. Each wave above is showing the medium's response to that energy

In a **transverse wave** the medium (the substance, represented by the curved line) is displaced along a line perpendicular to the direction of energy travel. The direction of energy travel is known as the wave's **propagation**. *Each successive particle in the path of the energy is displaced proportional to the amount of the energy. This displacement is measured as the **amplitude**.* The most distinct features of the transverse wave are the **crests** and **troughs**, which are basically the same parts simply opposing each other. *The distance between two successive crests/troughs is the **wavelength**.*

With the **longitudinal wave** the medium is displaced along a line parallel to the wave's propagation. Each successive particle in the path of the energy is forced to **oscillate** back and forth along the wave's propagation. The medium being used for a longitudinal wave has areas of high and low density due to the oscillations. The areas of high density are called **compressions** and the areas of low density are **rarefactions**. The amplitude is the difference between the rest density of the medium and the density of the compressed or rarefacted areas of the medium. The amplitude is also measured as the displacement of the actual particles from their rest position, just as a transverse wave.

The wave characteristics thus far have been "visible" ones. The others are not "visible" but are very important: frequency/period and wave speed/velocity. *The frequency of a wave is simply how many wavelengths of energy are produced and propagated over a period of time.* To be able to compare frequencies of different waves the standard SI unit called a Hertz (Hz) was developed. 1 Hz = 1 wave per 1 second. *The period of a wave is simply the time a single wavelength of energy takes to pass a given point.* Note that the period is the inverse of the frequency. There is no distance involved with either of these.

The distance factor comes in to play when you want to know how fast the wave is travelling. The most obvious way to find the speed of a wave is no different than any other speed calculation: you need a distance and a time for that distance. To be more specific to waves the most obvious distance is the wavelength and the time for that distance is the period. SO...the wavelength divided by the period is the wave speed. Or more conventionally...*the wavelength times the frequency gives you the wave speed.*

$$v = \lambda \cdot f$$

In addition to observing waves travelling through an unchanging medium it is also useful to observe how waves behave as the medium and its environment change.

Reflection occurs when there is a barrier through which the wave cannot travel completely, if at all. The wave will bounce off similarly to a tennis ball off the floor according to the law of reflection.

Refraction occurs when the speed of a wave changes due to a change in the medium, cold air to warm air for example. This change in speed results in a change in direction if the wave is at an angle to the change in medium boundary.

Diffraction is the bending of a wave around a barrier or through an opening. When the wavelength is sufficiently larger than the barrier or opening the diffraction will be more noticeable.

Wave interference occurs when two or more waves combine to produce a new wave pattern. This can be detected easily with two sounds of slightly differing frequency as a "warbling" of the sound known as beats. With light you observe alternating light and dark bands.